Answers to ‘CMEs and Flares’ Quiz

1. Describe solar flare:

A sudden brightening observed over the Sun's surface or the solar limb, which is interpreted as a large energy release. Most of the strong flares originate from the active regions.

2. How are solar flares classified:

Flares are classified by the X-ray flux intensity in the 0.1 – 0.8 nm wavelength range. A strong flare usually manifests itself by a sudden jump of the X-ray intensity.

3. What can be the space weather impact of the flares:

The flares can cause radio blackout through changing the structures/composition of the ionosphere (sudden ionospheric disturbances) due to x ray and EUV emissions.
Affect radio communications, GPS, directly by its radio noises at different wavelengths.
Contribute to solar energetic particles (SEP) - proton radiation, with damaging effects on satellite instruments.

4. Describe the coronal mass ejection (CME):

An eruption of a huge mass of solar plasma from the solar atmosphere occurring from time to time.
If CME is directed towards Earth, depending on it’s speed and size, it can reach the Earth in 1-3 days. CMEs are usually causing the strongest geomagnetic storms.
Statistics shows that during the solar activity maximum there are about 5 CMEs per day, and during the solar minimum few CMEs a week (the ratio is of the order of 10).
Most of the CMEs originate from active regions, areas with an especially strong magnetic field.

5. What can be the space weather impact of the CMEs:

Contribute to solar energetic particle (SEP) radiation, result in a geomagnetic storm, result in electron radiation enhancement in the near-Earth space.
This can affect spacecraft electronics, radio communications, navigation (GPS), power grids etc.

6. What is the physical mechanism behind the flares and CMEs:

It is believed that the magnetic field can change its configuration in a constantly varying solar atmosphere and during this reconfiguration it releases energy accelerating solar plasma causing flares and CMEs. The scientists are still debating on the details of the mechanisms, but the fact that the magnetic field is involved somehow is accepted by everybody.

Answers to Optional Homework:

1. What is the class of a flare if it's Flux is 2.5*10^(-4):

X2.5

2. What is the correlation between solar flares and solar activity:

The flares happen more often during and close to the solar maximum, but strong X-class flares can occur any time sunspots are present.

3. Describe Solar Flare Classes:

Flares are classified according to their X-ray Flux intensity in the 0.1 – 0.8 nm wavelength range:

Flux[Wm^(-2)] > 10^(-4)	X - (eXtreme), strong
Flux[Wm^(-2)] > 10^(-5)	M – (Moderate)
Flux[Wm^(-2)] > 10^(-6)	C – (Common)
Flux[Wm^(-2)] > 10^(-7)	B – (Background)
Flux[Wm^(-2)] > 10^(-8)	A

4. Describe the filament eruption on the Sun:

Not all CMEs originate from the active regions. Filaments are formed in magnetic loops that hold relatively cool, dense gas suspended above the surface of the Sun. Magnetic instabilities cause filaments to raise and parts of it disconnect from the solar surface resulting into CMEs.

5. What is typical CME mass and speed:

Mass: $\sim 10^{14}$kg; Speed: few hundred - 3000 km/s

6. CME classification and SCORE scale:

CMEs are classified based on frequency of detection and speed. CME classification SCORE system complements flare classes:

S-type - speed less then 500 km/s
C-type (common) - speed range 500-999 km/s
O-type (occasional) - speed range 1000-1999 km/s
R-type (rare) - speed range 2000-2999 km/s
ER-type (extremely rare) - speed more then 3000 km/s